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Design of Graft Block Polymer Thermoplastics

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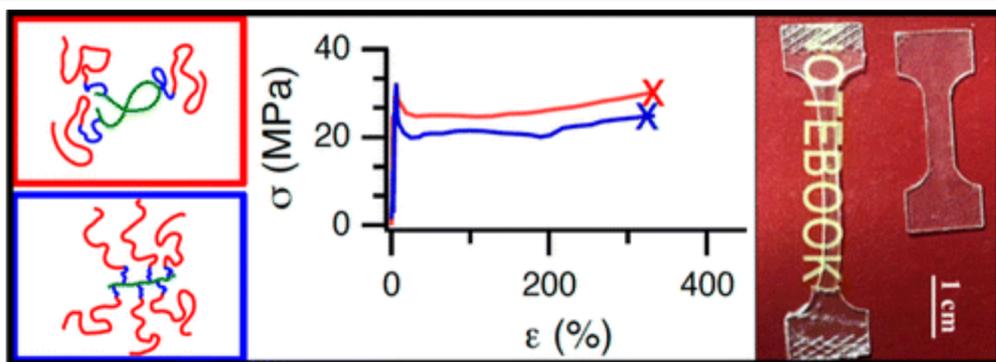
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Abstract



Graft block polymers are defined by several architectural parameters, including backbone flexibility, graft density, backbone length, side-chain composition, and side-chain length. In this work we probe the impacts of each of these parameters on the phase behavior, rheological properties, and mechanical performance of these materials. Specifically, we examine two sets of materials prepared from backbones of different inherent flexibility. One set was prepared from poly[(n-butyl acrylate)-co-(2-hydroxyethyl acrylate)] (B_xE_y) copolymers; the other was prepared from hydroxypropyl methyl cellulose (HPMC) samples. Sequential ring-opening transesterification polymerization from these hydroxyl-functionalized macroinitiators yielded a diblock graft architecture containing a rubbery interior block and semicrystalline exterior blocks tethered to a flexible (B_xE_y) or rigid (HPMC) backbone. Good control over side-chain molar mass and composition and judicious choice of the graft block segments enabled the preparation of materials that were either ordered or disordered in the melt state. In the former case, crystallization destroys existing order in the material; in the latter case crystallization induces new microphase separation in the bulk. Many of the structure–mechanical property relationships observed for graft block copolymers with rigid backbones are maintained for graft block polymers with semiflexible backbones, including the tendency for samples to remain transparent when stretched. However, interestingly, the effects of graft density and backbone length are quite different depending on the rigidity of the backbone.



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